

**Claims**

What is claimed is:

1. A semiconductor device, comprising:  
a semiconductor substrate;  
5 an active region formed in the substrate proximate an upper surface of the substrate,  
the active region including at least one circuit element formed therein; and  
at least one channel formed in a back surface of the substrate opposite the upper  
surface of the substrate, the at least one channel being formed proximate the active region;  
wherein the at least one channel is substantially filled with at least one layer of a  
10 thermally conductive material and configured so as to provide a thermal conduction path for  
conducting heat away from the active region.
2. The device of claim 1, wherein the at least one channel is filled with the thermally  
conductive material such that the at least one filled channel is substantially planar with the back  
surface of the substrate.
- 15 3. The device of claim 1, wherein the at least one layer of thermally conductive material  
comprises a metal.
4. The device of claim 1, wherein the at least one layer of thermally conductive material  
comprises at least one of copper, aluminum, gold, silver, a copper alloy, and an aluminum alloy.
5. The device of claim 1, wherein the at least one layer of thermally conductive material  
20 has a thermal conductivity greater than a thermal conductivity of the substrate.
6. The device of claim 1, wherein the at least one channel comprises one or more sloped  
sidewalls.

7. The device of claim 1, wherein the at least one channel comprises a substantially v-shaped groove.

8. The device of claim 1, wherein the at least one channel is formed using an etching process.

5 9. The device of claim 8, wherein the etching process comprises anisotropic etching.

10. The device of claim 1, wherein the at least one channel is formed proximate the active region.

11. The device of claim 1, wherein the at least one channel is formed through a length of the device between opposing sides of the device.

10 12. The device of claim 1, wherein the at least one layer of thermally conductive material has a coefficient of thermal expansion that is substantially matched to a coefficient of thermal expansion of the substrate.

13. The device of claim 1, wherein the device has a cross-sectional thickness greater than or equal to about six thousandths of an inch.

15 14. The device of claim 1, further comprising a plurality of active regions formed in the upper surface of the substrate and a plurality of corresponding channels formed in the back surface of the substrate, each of the channels being proximate a corresponding one of the active regions.

15. The device of claim 1, wherein the at least one channel is formed having a maximum height that is about two thousandths of an inch from the upper surface of the substrate.

16. The device of claim 1, wherein the at least one channel is formed having a maximum height that is about forty micrometers from the active region.

17. A method for forming a semiconductor device comprising the steps of:  
forming one or more active regions in a semiconductor substrate proximate an upper  
5 surface of the substrate, the active region including at least one circuit element formed therein;  
forming at least one channel in a back surface of the substrate opposite the upper  
surface of the substrate, the at least one channel being formed proximate the active region; and  
filling the at least one channel with at least one layer of a thermally conductive  
material so as to provide a thermal conduction path for conducting heat away from the active region.

10 18. The method of claim 17, wherein the step of forming the at least one channel  
comprises etching at least a portion of the back surface of the substrate.

19. The method of claim 18, wherein the etching step comprises anisotropic etching.

20. A semiconductor device, comprising:  
a base; and  
15 at least one integrated circuit die attached to the base, the at least one integrated  
circuit die comprising:

a semiconductor substrate;

an active region formed in the substrate proximate an upper surface of the  
substrate, the active region including at least one circuit element formed therein; and

20 at least one channel formed in a back surface of the substrate opposite the  
upper surface of the substrate, the at least one channel being formed proximate the  
active region;

wherein the at least one channel is substantially filled with at least one layer  
of a thermally conductive material and configured so as to provide a thermal

conduction path between the active region and the base for conducting heat away from the active region.